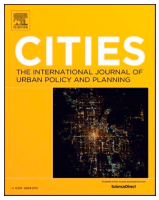
Cities 154 (2024) 105342

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities



Promoting migration for the formation of compact cities: A behavioral economics approach

Takashi AOKI *

Division of Global Architecture, Graduate School of Engineering Osaka University, Suita-City, Japan

ARTICLE INFO

Keywords:
Compact cities
Urban sustainability
Behavioral economics
Migration promotion
Shrinking cities
Prospect theory

ABSTRACT

Compacting mature cities is necessary to maintain a sustainable urban structure. This trend is also being considered as a countermeasure for shrinking cities and is being addressed in various regions of developed countries. However, optimizing city size in response to a declining population is unprecedented and requires further examination. A key challenge in this context is encouraging existing residents in areas where shrinkage is desired to relocate to the city center. Given their right to reside in the area, it is necessary to encourage voluntary relocation rather than forced exclusion. Therefore, this study explores the possibility of migration promotion measures that incorporate a behavioral economics perspective. Psychological trends, including Prospect Theory and Sunk Cost thinking, were identified. In addition, the younger generation and those approaching retirement were found to be desirable for promoting resettlement. The findings of this study can guide municipalities in pursuing compact city policies for the redevelopment of city centers and promoting migration. From an academic perspective, this study demonstrates that behavioral economics can be applied to residents living on the fringe of conurbations in a society with a declining population.

1. Introduction

1.1. Background

The sustainability of urban and residential environments has been a longstanding topic of discussion. More recently, the concept of livability has been introduced to coexist with nature in the discourse on compact cities (Shen et al., 2011). The transformation from a car-based society to an urban structure based on public transport and walking, while maintaining appropriate urban density, is considered desirable (Aoki, 2023a). However, the conceptualization of compact cities and related urban structures varies in meaning between the mature and growth phases (Nadeem et al., 2021). Excessive overdevelopment must be controlled during growth (ibid.). In contrast, mature cities must gradually reduce their expanded bases over time (Aoki, 2023b).

Population size optimization in mature cities has necessitated strategic urban contraction. Most cities in developed countries have expanded but are now experiencing population decline and shrinkage (Oswalt & Rieniets, 2006). The term “shrinking city” is well known in the context of urban planning as the phenomenon of spatial and economic shrinkage caused by population decline in mature cities (Haase et al., 2014; Hartt, 2021; Mallach, 2023; Weaver et al., 2016). Spatial shrinkage is reflected in a city by vacant lots and houses (Reis et al., 2016) that occur when its density lessens; subsequently, disaster prevention, landscapes, and public safety deteriorate [Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Housing Bureau, 2022]. Urban leaders face the challenge of shaping an environment suitable for demographic stagnation and an aging society (Kötter, 2019). This challenge becomes particularly pressing in the context of a declining population in the medium-to-long term. Cities that are inappropriately sized for their population may struggle to sustainably finance public expenditures, such as infrastructure development, as financial resources taper off. Additionally, in excessively low-density areas, public transport and essential services may be withdrawn (Jarzebski et al., 2021; Takemoto et al., 2019). Restructuring cities into compact urban areas appropriate for their population sizes is essential for sustainability.

However, the phenomenon of shrinking cities exists in several patterns, which have not normally existed in the outer edges of cities or a conurbation. One of them—urban perforation, characterized by the random occurrence of localized density reduction—poses an obstacle to creating people-friendly and sustainable cities (Denis et al., 2021; Hollander et al., 2009; Rink & Siemund, 2016). Localized density reduction

* S1-812, 2-1 Yamadaoka, Suita-City, Osaka 565-0871, Japan.
E-mail address: aoki_takashi@arch.eng.osaka-u.ac.jp.

https://doi.org/10.1016/j.cities.2024.105342
Received 1 February 2024; Received in revised form 30 July 2024; Accepted 3 August 2024
Available online 15 August 2024

may appear in spatial patterns that differ from those anticipated by city planning (Chhetri et al., 2013). For scattered low and unused lands, the value and opportunity of the area to attract necessary investments decline, impeding compact city policies (Ministry of Land, Infrastructure, Transport and Tourism (MLIT), 2015; MLIT City Planning Division, 2018). Moreover, shrinking cities can take the shape of a doughnut. They become hollowed-out within a 1 km radius of major public transportation stations, and the likelihood of future outbreaks is identified in areas with a concentration of urban functions (Aoki, 2022a; Aoki, 2022b). Thus, spatial control is necessary to manage low-density areas while encouraging people to move to designated areas.

Japan's population began to decline in 2008, resulting in a declining birth rate and an aging population. Cities began to shrink not only because of population outflow but also because of natural attrition. In 2014, a location-normalization plan was introduced as a countermeasure. In this plan, the municipality draws boundaries over the existing urbanization promotion areas stated in the urban master plan. Urbanization promotion areas in Japan are urban planning areas stipulated in Article 7 of the Urban Planning Law. Based on this law, prefectural administrations can designate areas where the town has already developed into an urban area and areas that should be developed on a priority and planned basis within approximately 10 years.

In contrast, location normalization plans are mainly formulated by municipal administrations. The plan aims to establish a basic policy on the location normalization plan for housing and urban function enhancement facilities, as stipulated in Article 81 of the Law on Special Measures for Urban Regeneration, which was amended in 2014 to allow each municipality to formulate such a plan. In this plan, municipalities can designate residential attraction areas and define areas that they consider suitable for the future. Establishing a residence-attraction area narrower than the urbanization promotion area can contribute to the formation of a compact conurbation. The goal is to create a network of compact centers. However, while it can provide incentives for living in or developing residential attraction areas, it cannot force residents to move.

Despite differences in geographic and policy factors, urban planners in various mature countries and regions may have to address urban compactness in societies with broadly declining populations. In addition, there is a possibility that even currently developing cities will eventually reach maturity and face population decline. In societies where individual rights are respected, displacing residents living in areas where contraction is forcibly desirable is difficult. Enhancing the living environment in residential attraction areas, providing economic incentives for migration, or significantly deteriorating the living environment in frontier areas can be expected to have a certain effect on encouraging people to migrate (Yamazaki et al., 2015). However, there are limits to providing economic incentives in municipalities with declining populations and deteriorating finances. In addition, deteriorating the living environment in current areas of residence may increase conflicts due to significant public opposition.

Considering the above, in conurbations that have matured and entered a period of contraction, compacting is recommended from the standpoint of improving social and natural sustainability. However, financial limitations and lack of migration enforcement have prevented the planned withdrawal of frontier areas. Therefore, it is necessary to encourage residents to consider migration positively. The means of doing so include not only economic incentives but also lowering psychological hurdles and motivating people to migrate. This study focused on Japan, one of the fastest-declining populations globally, as a model to consider measures for optimizing city size. This study aimed to examine the psychological aspects of residents while promoting future migration and appropriate urban contractions. For this purpose, this study primarily utilized behavioral economic theories that might be adaptable to residential environments. The social achievement that this research foresees will contribute to the development of a psychological approach to the optimization of city size in an era of population decline. On the academic side, this study demonstrates the potential adaptation of several behavioral economic theories to urban planning studies in an era of shrinking population in terms of migration promotion.

1.2. Related works

1.2.1. Different countries' policies for tackling shrinking cities

In the shrinkage methodology, governors draw boundaries for existing urbanized areas, facilitating continuous urban revitalization within the demarcated area and the non-utilization of land. They cooperate with private companies to demolish vacant lots and develop new buildings in revitalization centers (Bernt, 2007). For instance, Amsterdam created a compact urban plan to cope with rapid urbanization and continuous mobility growth while maintaining the identity and history of previous urban planning (De Roo, 1998; Inagaki, 2001). In Germany, urban shrinkage is a national challenge addressed through the Stadtumbau Ost Plan (Nelle et al., 2017), a federal program that helps municipalities suffering from urban shrinkage adjust the size of both land and population by reducing excessive housing supply and preserving critical housing stock (Hattori, 2016). Furthermore, attempts have been made in Germany to incorporate the problems and interests of the private sector, such as the housing industry, and hybrid urban planning approaches are being tested through joint public-private partnerships (Bernt, 2019). Globally, urban downsizing efforts aim to identify and problematize precise conditions, create the political will to tackle the problem, and establish conditions to decontextualize it (Hattori et al., 2017; Mallach et al., 2017).

The Japanese government has identified location normalization planning as a critical measure for compacting but has yet to establish enforceable residential attraction zones at the municipal level (Hashimoto et al., 2021). Some municipalities that have established residential attraction zones aim to make them coincide with current urbanization promotion zones, whereas others aim to reduce them to narrower areas (Nishii et al., 2019). Designating existing urban areas as residential attraction zones is similar to the existing system but ineffective in promoting compactness (Motomura et al., 2020). Local Japanese governments are gradually working to create cities appropriate for their population size. However, subsidy benefits at the time of relocation, the primary incentive method, must be increased to achieve compaction (Takema & Sato, 2017), and further strategic reduction measures must be considered.

1.2.2. Research about migration

Studies on promoting such residential inducements have explained the housing needs of new residents, their reasons for moving to the area, and their relationship with the workplace and child-rearing environment. The reasons for moving typify residential preferences and can vary from person to person in terms of whether daily convenience or environmental conditions are prioritized (Nishiyama et al., 2011). In local cities, a certain number of households residing in the suburbs consider moving to the city (Nakatani et al., 2019). It has also been found that people seeking urban facilities for daily use, including employees, tend to seek compact conurbations (Gim, 2023). These studies focused primarily on arrival points and how housing and facility environments lured them.

Some studies have investigated the likelihood of relocation from a psychological standpoint, particularly from a behavioral economics-related perspective. However, these are primarily analyses of broadband migration. For example, loss aversion based on Prospect Theory has been identified in the migration process to Germany and in the life satisfaction of forestry workers (Czaika, 2015; Hong et al., 2023). Behavioral economics aspects have also been identified in migration decisions in free movement between European Union countries, and they can vary depending on individual characteristics (Žičkutė & Kumpikaitė-Valiūnienė, 2015). These studies mainly analyzed intercountry and interregional migration processes, which differ from the

promotion of migration from the periphery to the city center, contributing to compactness. In addition, various research discusses the suitability of prospect theories for house relocation with the perspective of the effect of loss aversion, and internal and external reference points (Wang et al., 2015; Yan et al., 2018). However, their point of view considers the stage of development and expansion of cities and not shrinkage, which is the focus of our study.

1.3. Aims and scope

The primary focus of this study was to explore the feasibility of a psychological approach to promoting the migration of peripheral dwellers. Furthermore, we examined the optimization of the size of mature cities in societies with declining populations. Therefore, our investigation centered on conurbations in Japan experiencing population decline, analyzing residents' intentions to relocate while incorporating the perspective of behavioral economics. The novelty of this study lies in its focus on the migration potential of peripheral residents for the formation of a compact and sustainable urban structure. In this study, we hypothesize:

1. Loss aversion in Prospect Theory can be adapted to changes in the residential environment.
2. Behavioral economics theories, such as Sunk Costs, can be applied to promote migration.
3. The approach to promoting migration can be adapted differently, depending on the demographics of the residents and their intentions to continue living in the area.

2. Methodology

2.1. Study setting

This study employs behavioral economics to examine the psychological aspects of relocation challenges and opportunities for residents living in areas where future contraction is desirable, aiming to create more compact conurbations. The analysis in this study is based on a questionnaire survey conducted in 2022 in the target areas, with questionnaires distributed in three steps.

Initially, residents within the conurbation of the same subject were targeted. The Kyoto-Osaka-Kobe conurbation, the second-largest in Japan, has experienced a population decline in recent years and serves as the target area. Next, municipalities belonging to this conurbation with location optimization plans were selected. However, some municipalities have set their location optimization plans to overlap with existing urbanization control areas. Finally, municipalities with location optimization plans covering a smaller area than the conventional urbanization promotion area were identified. These excluded areas were set as the target areas for questionnaire distribution.

The municipalities with the target areas for distributing the

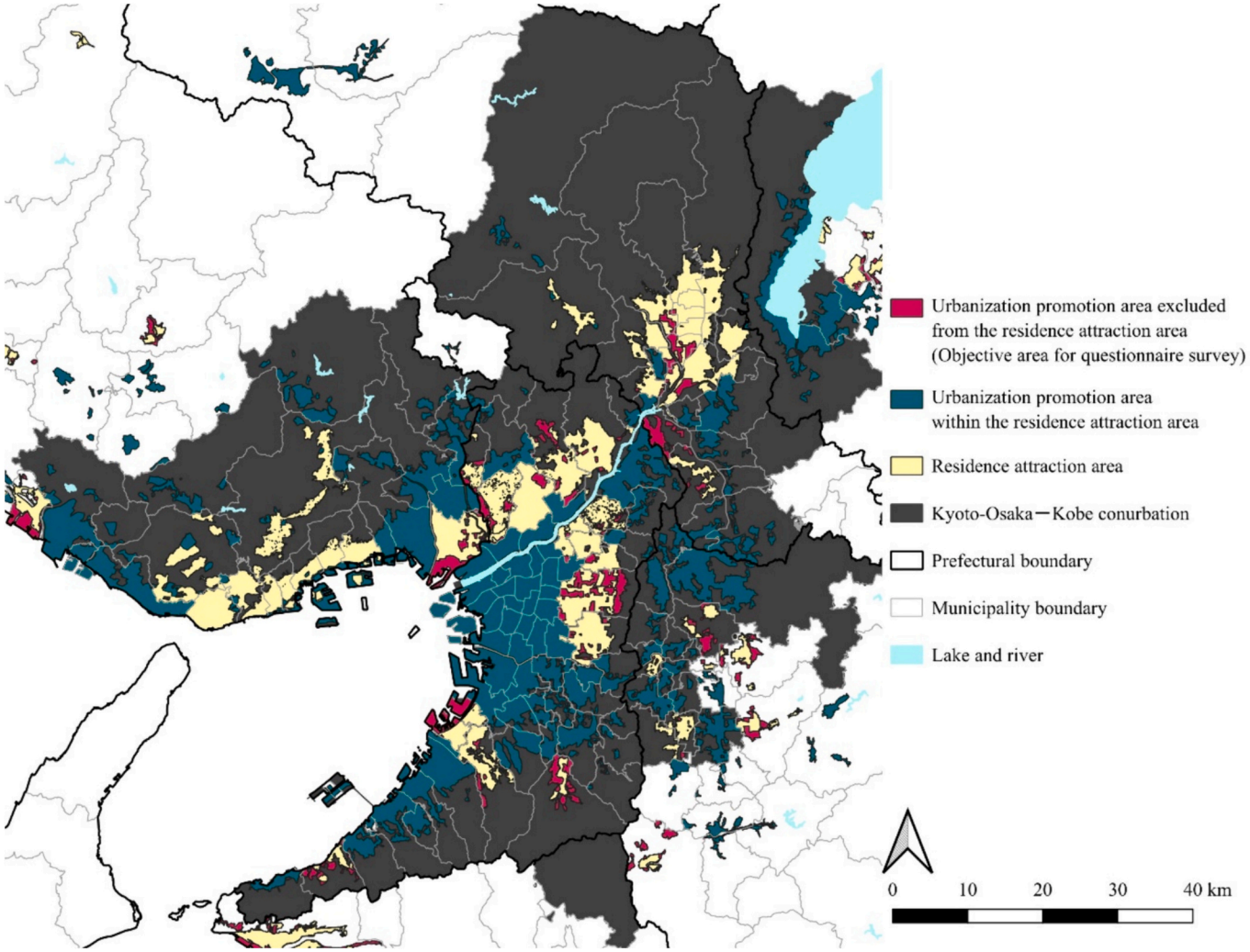


Fig. 1. An overview of target area for study.

questionnaire sheets are shown in Fig. 1. Municipalities with fewer than 100 households in the target area were excluded because individuals could only be identified based on the response results. Although web-based questionnaires have been developed recently, the distribution strategy opted for traditional mail due to the expected presence of a significant number of older adults in the target area. The distribution period and the number of questionnaires distributed are listed in Table 1. Two distributions were conducted owing to the combination of the number of valid responses. The overall collection rate was lower than that for the first distribution, but a total of 587 responses were eventually obtained. Based on the census as of 2020, the total number of households in the area covered by the distribution was 167,808. For this population, the number of responses to this questionnaire, 587, has an acceptable margin of error of ±4.0 % (95 % confidence level) and is sufficiently valid.

2.2. Definition of the basic data of respondents

The survey results were summarized in terms of the respondents' age group, household composition, annual household income, and type of employment. Additionally, the survey assessed the continuity of residence in the current residential area and the level of understanding that the area is outside the residential attraction area of the location normalization plan. In cases of incorrect or multiple answers, where a single answer was provided, only the relevant item was considered non-responsive. Therefore, the total number of responses may have been less than that collected for some items.

Based on Japan's Institute of Populations and Social Security (IPSS) (2016) demographic data, the marriage rate for both men and women was the highest in the 25–29 age group and the second highest in the 30–34 age group, with the reproduction rate peaking in the 30–34 age group. This study distinguishes between young and middle-aged groups, considering those in the 20–34 age group as individuals entering the workforce and getting engaged, whereas those in the 35–49 age group are considered the center of the workforce and are often parents. With the recent update of the retirement age in Japan to 65 years, this study defines residents aged 50–64 as those in the stage of making their children independent and preparing for retirement. Thus, the study classifies age groups into five categories: Young (20–34), Middle-aged (35–49), Pre-retired (50–64), Early-elderly (65–74), and Elderly (over 75).

2.3. Residents' loss aversion and the evaluation for their current living environment

Prospect theory in behavioral economics encompasses three psychological effects: loss aversion, reference-point dependence, and diminishing sensitivity (Kahneman & Tversky, 1979). Loss aversion refers to the psychological act of choosing to avoid "losing money" rather than gaining money. Reference-point dependence refers to the psychological action of judging value "relatively" rather than "absolutely." Diminishing sensitivity denotes the psychological effect of becoming less sensitive to the same amount of loss as the population grows.

Table 1
Basic data of questionnaire survey.

	First distribution	Second distribution	Total
Distribution period	Dec.1st - 14th, 2022	Feb. 15th-22nd, 2023	–
Data of last collection	Jan. 10th, 2023	Mar. 6th, 2023	–
Number of households to distribute	3000	1000	4000
Number of valid responses	462	125	587
Valid response rate	15.4 %	12.5 %	14.7 %

Three cases can be envisioned where loss aversion is adapted to changes in the living environment due to relocation. Fig. 2 shows a schematic diagram of these cases, where the x-axis represents the increase or decrease in the goodness of a particular residential environment element, and the y-axis represents the satisfaction the respondent derives from that increase or decrease. The value each resident places on their current living environment deserves consideration. If the living environment changes by the value of x in a negative direction compared with the current situation, the respondent is assumed to feel a sense of loss by the value of y in response to the change. Conversely, when the transition is in the positive direction of the value of x, it is assumed that the respondent will be satisfied based on the value of y.

In Case 1, x_1 and x_2 are equal, balancing gains and losses. This does not correspond to loss aversion; the idea is that if the possibility of improvement is equal to the possibility of loss of the living environment, relocation is considered a good idea. In Case 2, x_3 is more significant than x_4. This indicates the opposite of loss aversion. If there is a possibility of even a slight improvement in the living environment, respondents tended to choose that possibility over the risk of deterioration. Finally, in Case 3, x_5 is minor compared to x_6. This tendency corresponds to loss aversion in behavioral economics. Satisfaction with gains is low relative to the sense of loss gained from losses, fostering a tendency toward loss aversion thinking.

The following questionnaire items were designed for this survey based on the above cases:

> Q: Suppose that the environment of your neighborhood will change in the future due to moving or redevelopment. In that case, the environment in the new area could be better or worse than it is now. If there is a 50% risk that each of the following items will be "a little worse than where you live now," while there is a half chance that the same item will be "how much better than where you live now" in the other half of the cases, would you decide to live in that area?

The choices are as follows:

A) About the same as the current environment.
B) A little better than the current environment
C) Fairly better than the current environment
D) Much better than the current environment
E) Very much better than the current environment

Given that the perceived risk in the question text is "a little worse," the corresponding option that balances this is B, corresponding to Case 1. Hence, the dummy variable for Alternative B is set to 0. Based on this, we assume that option A is −1, C is +1, D is +2, and E is +3. In alternative A, the expected profit is less than the risk; therefore, it is considered Case 2. Finally, alternatives C-to-E fall under Case 3, but items D and E are more loss-averse.

In addition to loss aversion in Prospect Theory, diminishing sensitivity has also been identified. In the context of habitat evaluation, when the value of the current habitat was high, a slight decrease was less likely to cause a sense of loss than when the evaluation of the current habitat was low. Therefore, respondents were asked to evaluate their current living environment using the same items, in addition to evaluating the value of benefits for the risk of possible loss described above. The results were rated on a scale of 1 to 10.

2.4. Priority and equivalence of living environment

Loss aversion was the only difference in the perception of value within the same residential environment. However, another perspective suggests that it may be acceptable for the situation of one item to worsen if that of another item improves. To explore this, we retained the same items used in the survey on loss-averse thinking and asked the following questions: Participants were asked to provide a pair of desired items and items they would be willing to abandon. Each participant participated in

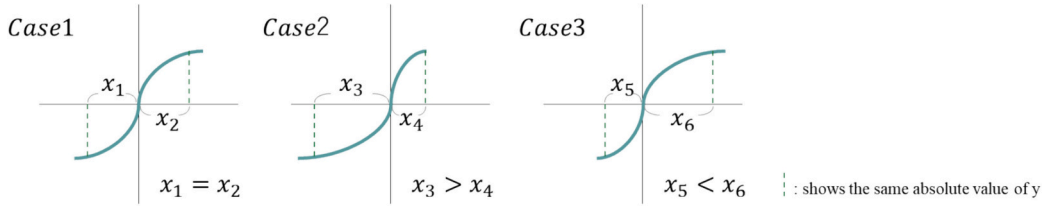


Fig. 2. Schematic diagram of loss aversion.

up to three pairs, and each item was selected only once.

Q: Suppose that when the environment in which you live changes, in order to make some items better, you have to accept that another item will be worse. At this time, which item would you give up in place of which item?

2.5. Potential for residency promotion policies from a behavioral economics perspective

In addition to Prospect Theory, this study explores factors that promote positive relocation from a psychological perspective, employing multiple perspectives within behavioral economics (Just, 2013). Among the numerous phenomena in behavioral economics, survey items were crafted based on theories deemed applicable to the residential perspective. The six theories used in this study are Sunk cost (Concorde effect), Present bias, Heuristic, Bandwagon, Herding, and Obedience to authority. Respondents were asked to rate 17 items based on the above perspectives on a 6-point scale: 1.0 not at all, 2.0 not applicable, 3.0 not very much, 4.0 somewhat applicable, 5.0 applicable, and 6.0 very much applicable.

■ Sunk cost (Concorde effect): The psychology of continuing the same behavior, even if it is irrational, to recover the cost paid up to that point (or to obtain an equal or more significant benefit) (Arkes & Ayton, 1999).

a) Because we have paid loans and rent, we should continue to live in our current residence/area even if we are dissatisfied.
b) Because we have spent a lot of time and effort getting used to living here, we should continue to live in our current residence/area, even if we are dissatisfied.
c) We should move if there is a better place to live, regardless of the time, effort, or money spent.

■ Present bias: Psychological preference for maintaining a status quo that attempts to avoid the stress and anxiety of choosing an action or decision that differs from the status quo (Samuelson & Zeckhauser, 1988).

d) I would choose to live in a city that would be a little livable right now, compared to a city that would be very livable after a few years.
e) I would choose to live in a city that would be a little challenging to live in right now, compared to a city that would be very challenging to live in after a few years.

■ Heuristic: Psychology that simplifies and captures complex information based on an individual's experience and information; behavior that makes decisions based on empirical (heuristic) rules (Shah & Oppenheimer, 2008).

f) Even if there is a city that better suits our lifestyle, we will stay the same because we are accustomed to living in our current area.
g) If we were to move, we would prefer an area similar to our current area.
h) I have had many good (bad) memories of my current area and I will probably have many good (bad) events in my current area in the future.
i) When we visit a city for the first time by train, if the station building and the square in front of the station are attractive, the entire city is considered a good area.

■ Bandwagon: Psychology of judging a situation that many people support as "good" regardless of whether they are interested in it, and acting in the same way as those around them (Marsh, 1985).

j) No matter how much we like the home/area, we feel differently if other people say it is not attractive.
k) If our neighbors or people I know consider moving to a new place, we will want to move there.
l) When we see many new houses and buildings, we imagine ourselves living in them.
m) When we read articles such as "The Best Places to Live," I felt that I would like to live in a town that ranks highly on the list.

■ Herding: Psychology in which one avoids acting differently (or belonging to a minority) and tries to be in tune with the behavior of those around them. Unlike the bandwagons, the majority group does not support anything, particularly in herding (Hwang & Salmon, 2004).

n) The house or area looks nice when we see an eye-catching real estate advertisement.
o) We want to live in a house/area recommended by a celebrity on TV, YouTube, etc.

■ Obedience to authority: Psychology of feeling that what is in authority (or what is espoused by those in authority) is correct (Milgram, 1965).

p) We want to live in a house or area introduced by a famous magazine or architect.
q) Areas being redeveloped by the government as "good places to live" are attractive.

The results obtained from these response items were tabulated to test the theory of likely influence. Given the likelihood of these psychological hurdles varying among individuals, respondents were categorized based on the degree of influence of behavioral economics, potentially impacting residential transitions. Thus, we proposed the classification analysis based on the above items. To ensure precision, each item was answered on a ranking scale, and respondents were classified based on the similarity of these response trends.

Hierarchical cluster analysis was used to create the typologies in this paper. The variable used to measure the distance of similarity between respondents in this analysis was each respondent's scale for items *a* to *q*. After calculating the distances between respondents, we proceeded to typify the respondents based on the Ward method in order to avoid excessive group bloat while circumventing the extraction of an excessive number of groups. Non-hierarchical cluster analysis (k-means method)

was also used. However, this is the first study to analyze the influence of behavioral economics theories on residential location choice, and because it is difficult to estimate the initial number of clusters, which is important in non-hierarchical cluster analysis, we used hierarchical cluster analysis.

2.6. Relationship between typologies of behavioral economics, respondent attributes, and loss aversion thinking

The trend of the behavioral economic items *a* to *q* tends to be affected by individual respondent characteristics, which were considered to exhibit variations. Thus, the clusters observed in our questionnaire survey have the possibility of the biased attributes of respondents belonging to each cluster. To discuss Hypothesis 3, we should identify the pronounced respondent characteristics that fall under the typology of respondents derived from the characteristics of behavioral economics.

This analysis aims to clarify the bias trend of each respondent's characteristic belonging to each cluster. The characteristic categories that this study focused on include the questionnaire respondents' age, household composition, annual household income, and employment status. All respondents' characteristics comprise categorical data rather than numerical data, as ease of response had to be prioritized for the convenience of creating the survey instrument. Thus, we conducted a Pearson's chi-square test to observe the relationship between two different categorical data, which comprise the cluster of behavioral economic tendency and the respondents' characteristics. However, a Fisher's exact test was employed in cases where the error terms were not distributed identically, independently, or with normal distribution, which is called a conflict with Cochran's theorem.

The categorical data for each characteristic of respondents we asked on the questionnaire included *Age:* Young-aged, Middle-aged, Pre-retired, Early elderly, Elderly; *Household composition:* Single, Couple, Nuclear family, Other; *Annual household income:* under 4 million yen, 4 to 6 million yen, 6 to 8 million yen, 8 to 10 million yen, more than 10-million-yen; and *Employment status:* Formal employment, Informal employment, Other.

In both analysis cases, the null hypothesis was that the categorical data of interest, i.e., clusters and age, are independent. In contrast, the alternative hypothesis states that there is an association between the categorical data. To identify independence, we considered a *p*-value of less than 5 % to be statistically significant in this paper.

Suppose we perform a Pearson's chi-square test and the null hypothesis of a cluster and a specific respondent attribute is rejected, confirming an association. At this point, we acknowledge some relationship between these two variables, but cannot specifically identify it. Therefore, an adjusted residual analysis is used to find out which items are specifically related to each other. The residuals are defined as "observed value minus expected value," and a residuals analysis can be used to find the combination of items with considerable discrepancies between expected frequency and observed value. Since adjusted residuals follow a standard normal distribution, we can determine that an item is distinctive when $\geq|1.96|$. As this analysis cannot be applied to a Fisher's exact test, the learning tendency is only considered based on the ratio of attribute categories belonging to each type when the quantiles are obtained with a Fisher's exact test.

3. Results

3.1. Basic data of respondents

The distribution by age group included 30 young individuals aged 20–34, 92 middle-aged individuals aged 35–49, 160 pre-retirees aged 50–64, 140 early-elderly individuals aged 65–74, and 87 elderly individuals aged 75 years and over, totaling 509 respondents. As most development areas were formed during the period of suburban expansion from the 1960s onwards, it is likely that the majority of households are composed of elderly residents. Regarding household composition, there were 71 single-person households, 168 couple-only households, 173 nuclear family households, and 100 other households, including three or more generations living together, totaling 512.

Economically, 508 respondents were divided into 199 formally employed, 81 informally employed, and 228 other employment types. Other types of employment included homemakers, students, and the unemployed, including retirees. In terms of annual household income, 204 households earned less than 4 million yen, 124 earned 4–6 million yen, 78 earned 6–8 million yen, 48 earned 8–10 million yen, and 49–earned over 10 million yen, totaling 503 households. According to the 2022 Survey of Private Sector Salaries (National Tax Administration Agency, 2022), the average annual income in Japan was 4.58 million yen. Slightly fewer than half of the respondents in this survey had a household income below the average annual income.

The study then investigated respondents' intentions to continue living in their current homes. The rating was on a six-point scale ranging from "very much agree" to "not at all agree" (Fig. 3). Less than 20 % of the respondents expressed a desire or consideration to move from their current residence. However, most residents preferred to remain at their current place of residence. It is worth noting that not all respondents strongly favored this idea; around 24.2 % of the respondents answered "so-so," indicating they are considering continuing to reside in their current home but are not firmly committed to it.

When asked whether they were aware that they were outside the residential attraction area of the location normalization plan, their responses are shown in Fig. 4. Only 9.5 % of the respondents correctly recognized this. In contrast, 11.9 % of the cases were misidentified. Furthermore, 75.8 % did not know whether they belonged to a residential attraction.

3.2. Residents' loss aversion thinking regarding their living environment

When deciding to move, survey respondents were asked how much they would like to see certain environmental items improve if they were likely to be slightly worse off than they are now. The responses were rated on a five-point scale: −1.0: approximately the same as at present, 0.0: a little better (approximately the same as worse), 1.0: fairly better, 2.0: much better, and 3.0: very much better. The survey covered 15 residential environment items, including the sufficiency of functions contributing to basic life activities; sufficiency of functions related to hobbies and leisure activities; sufficiency of nature (including parks); quality of the local community; and items related to safety (including accessibility).

Fig. 5 shows the mean values for each item. Community activeness and relationships scored −0.16 and 0.03, corresponding to CASE 1 and CASE 2, respectively, in Fig. 2. This suggests limited awareness of the need to avoid losses concerning the community's well-being. However, accessibility to public transport and insured healthcare facilities, such as hospitals, scored closer to 1.0, with particular awareness of loss aversion at work. This was followed by walkability-related items, such as safety and walkability, with values above 0.5. Items above 0.0 but relatively close to CASE 1 include nature in the city, such as street trees, and the availability of places for hobbies, lessons, and leisure activities.

Table 2 compares the above results with the current residential environment assessment and summarizes the differences in loss aversion thinking depending on how high or low these items are. Each row represents a living environment item, and the columns contain the average of the respondents who rated each item on a scale from 1 (very low) to 10 (very high). The correlation coefficients between these current rating items and loss-averse thinking are shown on the right side of the table. The correlation coefficients here are based on Jacob Cohen (1988) concept of correlation coefficients in the social sciences and psychology, with ±0.1 indicating a weak correlation, ±0.3 a normal correlation, and ± 0.5 a strong correlation.

Negative correlations are evident, except for items related to the

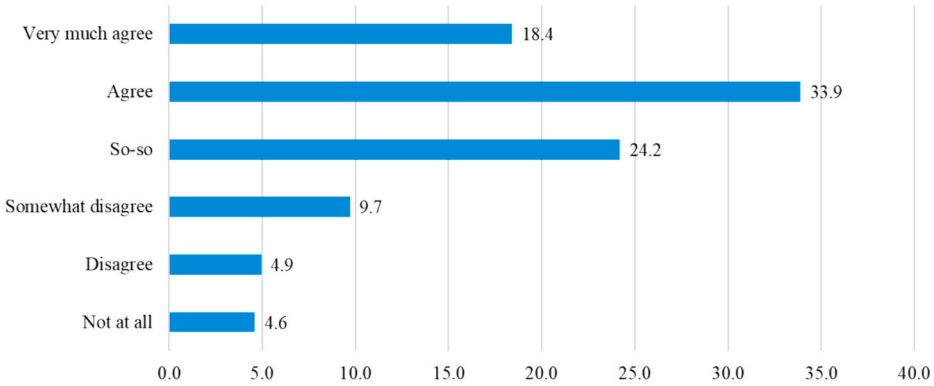


Fig. 3. Intention to continue living (%).

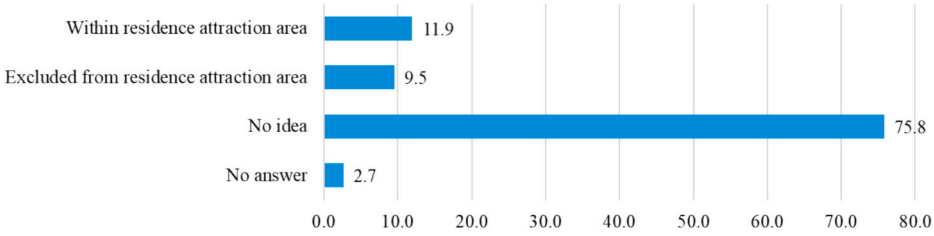


Fig. 4. Awareness of location optimization plan (%).

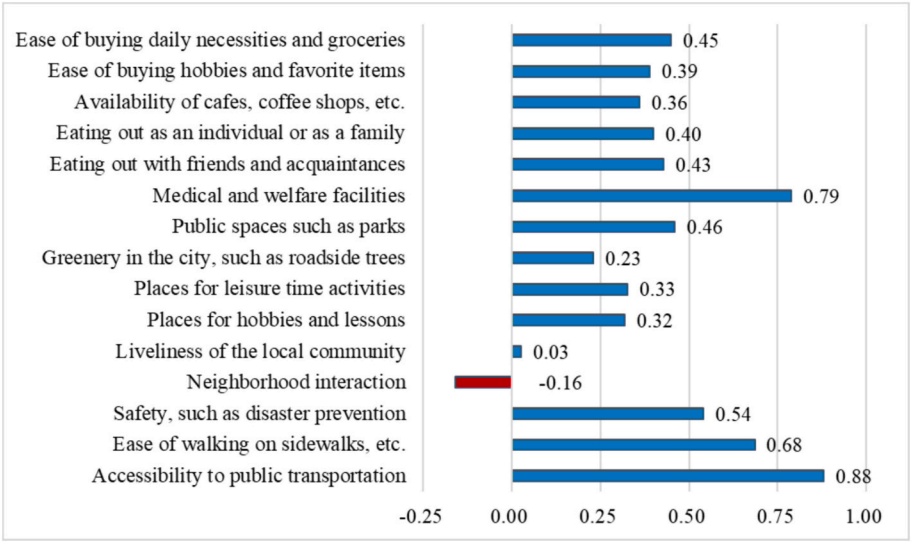


Fig. 5. Average loss aversion scores by living environment items.

community. The negative correlations were generally weak, with exceptions noted for ease of buying daily necessities and groceries, public spaces such as parks, greenery in the city, roadside trees, ease of walking on sidewalks, and accessibility to public transport. Individuals who rated the current situation less favorably tended to seek more robust returns and were observed to have more pronounced loss-averse thinking. This indicates that residential environment items can also validate the concept of diminishing sensitivity in Prospect Theory. Items that tend to seek a reasonable return while receiving a high evaluation of the current situation, regardless of correlation strength, include public spaces such as parks (0.04), the liveliness of the local community (0.50), and safety aspects such as disaster prevention (0.09). Some respondents answered CASE 1 or CASE 3 for these items, indicating a tendency to seek loss aversion even if the current situation was quite favorable.

3.3. Priority and equivalence of living environment

This section examines the potential compatibility of items beyond the relative value of the same item. In essence, this analysis aims to determine which items respondents would be willing to accept as being less than average if certain other items were improved, possibly due to relocation. Fig. 6 presents the results by subtracting the number of items to be abandoned from the number of environmental items selected as desired. The items are arranged in descending order based on their values.

The item with the highest number was the ease of buying daily necessities and groceries, followed by items related to health and welfare, public transport, and safety, which were more likely to be selected as desired items. Walkability and the availability of restaurants for

Table 2
Correlation between current conditions and perceived loss.

	Value on each environmental functions										Correlation coefficient		
	1: Very Low	2	3	4	5	6	7	8	9	10: Very High	Cor	p-value	Intensity
Ease of buying daily necessities and groceries	1.18	0.96	1.50	0.87	0.72	0.26	0.23	0.11	−0.11	−0.41	−0.434	**	cor
Ease of buying hobbies and favorite items	1.08	0.74	0.78	0.53	0.29	−0.02	0.31	0.05	−0.18	−0.44	−0.296	**	w_cor
Availability of cafes, coffee shops, etc.	0.63	0.33	0.65	0.19	0.15	0.11	0.00	−0.19	0.67	−0.10	−0.177	**	w_cor
Eating out as an individual or as a family	0.95	0.33	0.68	0.59	0.23	0.40	0.02	0.59	0.21	−0.92	−0.193	**	w_cor
Eating out with friends and acquaintances	0.86	0.50	0.46	0.39	0.29	0.21	−0.05	0.39	−0.13	−0.44	−0.187	**	w_cor
Medical and welfare facilities	1.86	1.13	1.22	1.05	0.75	0.65	0.49	0.43	0.44	−0.15	−0.270	**	w_cor
Public spaces such as parks	1.33	1.23	0.84	0.63	0.60	0.32	−0.01	−0.03	−0.05	0.04	−0.323	**	cor
Greenery in the city, such as roadside trees	0.76	1.03	0.87	0.61	0.26	0.21	−0.17	−0.25	−0.18	−0.10	−0.315	**	cor
Places for leisure time activities	0.62	0.44	0.48	0.39	0.12	0.35	0.15	0.28	−0.17	−0.17	−0.137	**	w_cor
Places for hobbies and lessons	0.73	0.55	0.33	0.30	0.17	0.28	0.04	0.35	0.20	−0.17	−0.140	**	w_cor
Liveliness of the local community	0.19	0.36	0.03	−0.03	−0.13	0.00	0.23	−0.19	−0.67	0.50	−0.083	–	–
Neighborhood interaction	−0.13	−0.06	−0.25	0.11	−0.22	−0.09	−0.25	−0.27	−0.14	−0.71	−0.077	–	–
Safety, such as disaster prevention	2.00	0.59	1.19	0.89	0.45	0.39	0.36	0.28	−0.09	0.09	−0.269	**	w_cor
Ease of walking on sidewalks, etc.	1.69	1.26	1.12	0.97	0.41	0.12	0.37	−0.08	0.15	−0.20	−0.418	**	cor
Accessibility to public transportation	1.84	1.10	1.51	1.15	0.92	0.89	0.63	0.12	0.20	−0.50	−0.448	**	cor

** p-value < .01.

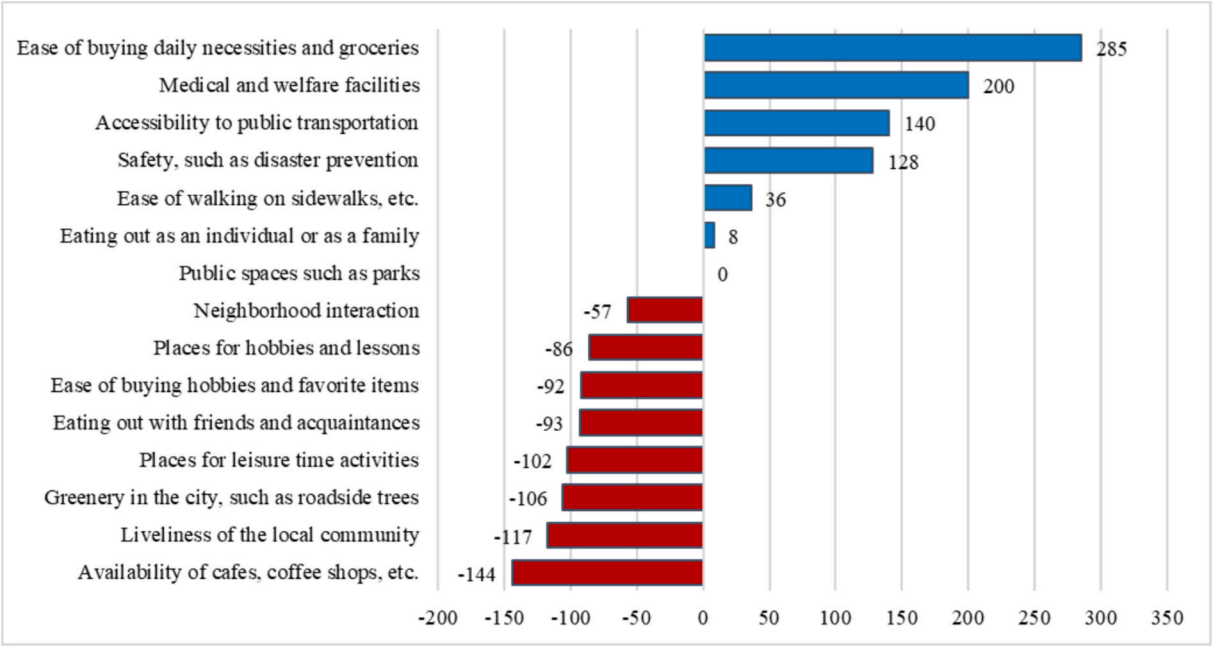


Fig. 6. Scores of intention-to-live by environment items.

individuals and families to dine out, although minor, also had positive values. Interestingly, public spaces, such as parks, had a value of +/−/0, indicating an equal number of items desired and abandoned. The most frequently expressed item to give up, particularly the availability of cafes, coffee shops, etc., had a value of −144. It appears that respondents are more willing to tolerate slightly worse living conditions for leisure activities, personal hobbies, and community facilities to improve daily life, safety, and convenience.

These factors also need to be examined in combination. Table 3 shows the percentages of pairs obtained in this study, with the desired items in the rows and the items to be abandoned in the columns. Pairs in the top 10 % are highlighted in red.

Thus, there is a tendency to give up places to buy things, mainly related to hobbies, to obtain the most desired items and the convenience of purchasing daily necessities. This pair was the most common, accounting for 16.4 %. Other abandoned items were those related to leisure activities and places for hobbies. Restaurants used by individuals and families exhibited higher compatibility only with restaurants used by friends, constituting 5.8 %. The decision is solely based on prioritizing elements within the same restaurant.

Public facilities, such as parks, emerged as characteristic items given up in favor of securing adequate medical and other facilities. No other items formed pairs for discontinuation. Additionally, none of the safety-related items appeared in the top 10 % of pairs. Safety did not exhibit

Table 3
Trade-off between includable and excludable items in living environment (%).

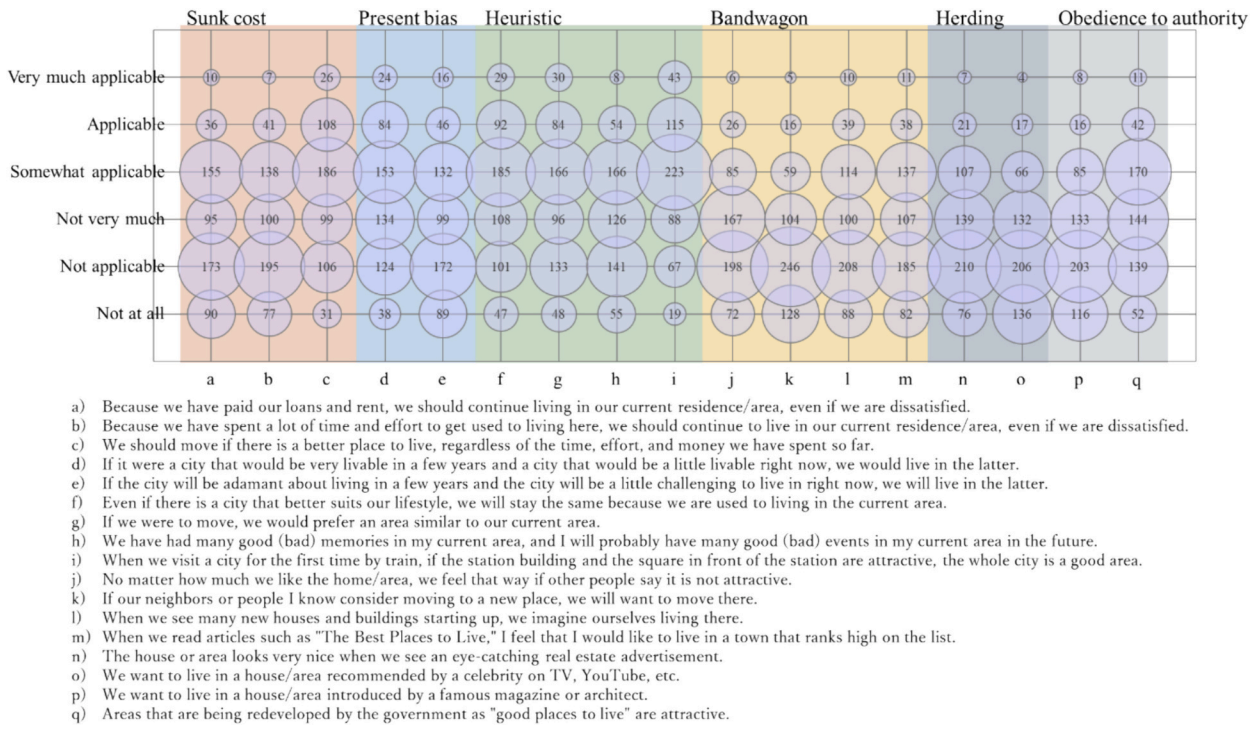
		Elements to abandon															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Desirable element	1		16.4	8.3	4.3	3.2	0.5	2.2	2.9	3.6	3.4	4.3	2	0.3	0.5	1.2	**53.2**
	2	1.2		2.9	0.5	1.2	0.9	0.9	0.7	1.5	1.2	1.5	1	-	0.3	0.3	**14.1**
	3	0.3	0.9		0.7	1.7	0.9	0.7	0.5	0.9	1	1.4	0.2	-	0.5	0.3	**9.9**
	4	0.7	0.9	2.7		5.8	-	0.7	0.5	1	0.5	1.4	0.7	0.3	-	-	**15.2**
	5	0.5	0.5	1.2	1.7		0.3	0.2	-	0.7	1	0.5	0.3	0.2	0.3	-	**7.5**
	6	0.2	3.7	6.5	1.7	3.6		4.3	2.6	6	4.1	3.1	1.4	0.3	-	0.9	**38.2**
	7	0.3	1.9	1.9	0.7	1.7	-		3.9	2	1.2	1.2	0.9	0.2	0.7	1.2	**17.7**
	8	0.2	0.5	0.5	0.9	0.3	0.3	1		0.3	0.3	0.2	0.3	0.2	2.6	1.4	**9.0**
	9	0.2	0.5	0.7	0.7	0.2	0.2	0.5	0.3		1.5	2.7	1	0.3	0.3	-	**9.2**
	10	-	0.7	0.3	0.3	0.2	0.5	0.7	0.5	1.4		1.7	1	0.3	0.5	0.2	**8.3**
	11	-	0.2	0.3	0.2	0.3	0.2	0.2	0.2	0.7	1.4		1.2	-	-	0.3	**5.1**
	12	-	0.5	0.9	0.2	-	-	0.3	-	0.2	0.2	1		-	0.5	0.7	**4.4**
	13	-	1.2	3.4	1.4	1.2	0.3	2	3.4	3.4	2.2	1.4	0.9		2.7	1.2	**24.7**
	14	0.3	1.2	1.9	0.3	1	-	0.9	6.8	1.7	1	1.2	0.3	0.2		2.4	**19.3**
	15	0.7	0.9	2.9	0.3	2.9	-	3.2	4.8	3.2	3.9	3.6	2.9	0.5	4.1		**33.9**
	TOTAL	**4.6**	**29.8**	**34.4**	**13.8**	**23.3**	**4.1**	**17.7**	**27.1**	**26.6**	**23.0**	**25.0**	**14.1**	**2.9**	**13.1**	**10.1**	

1	Ease of buying daily necessities and groceries	6	Medical and welfare facilities
2	Ease of buying hobbies and favorite items	7	Public spaces such as parks
3	Availability of cafes, coffee shops, etc.	8	Greenery in the city, such as roadside trees
4	Eating out as an individual or as a family	9	Places for leisure time activities
5	Eating out with friends and acquaintances	10	Places for hobbies and lessons
11	Liveliness of the local community		
12	Neighborhood interaction		
13	Safety, such as disaster prevention		
14	Ease of walking on sidewalks, etc.		
15	Accessibility to public transportation		

NOTE: Pairs in the top 10% are highlighted in red

strong compatibility with any particular item and tended to vary among respondents regarding factors they would be willing to give up.

Next, examining pairs of items related to walkability, only greenery in the city, such as roadside trees, made it into the top 10 %, accounting for 6.8 %. Individuals seeking walkability appear to be less attached to nature. Accessibility to public transport does not seem compatible with purchasing, medical, and dining facilities, and individuals tend to abandon their connection to nature and hobbies. Simultaneously, with



a) Because we have paid our loans and rent, we should continue living in our current residence/area, even if we are dissatisfied.
b) Because we have spent a lot of time and effort to get used to living here, we should continue to live in our current residence/area, even if we are dissatisfied.
c) We should move if there is a better place to live, regardless of the time, effort, and money we have spent so far.
d) If it were a city that would be very livable in a few years and a city that would be a little livable right now, we would live in the latter.
e) If the city will be adamant about living in a few years and the city will be a little challenging to live in right now, we will live in the latter.
f) Even if there is a city that better suits our lifestyle, we will stay the same because we are used to living in the current area.
g) If we were to move, we would prefer an area similar to our current area.
h) We have had many good (bad) memories in my current area, and I will probably have many good (bad) events in my current area in the future.
i) When we visit a city for the first time by train, if the station building and the square in front of the station are attractive, the whole city is a good area.
j) No matter how much we like the home/area, we feel that way if other people say it is not attractive.
k) If our neighbors or people I know consider moving to a new place, we will want to move there.
l) When we see many new houses and buildings starting up, we imagine ourselves living there.
m) When we read articles such as "The Best Places to Live," I feel that I would like to live in a town that ranks high on the list.
n) The house or area looks very nice when we see an eye-catching real estate advertisement.
o) We want to live in a house/area recommended by a celebrity on TV, YouTube, etc.
p) We want to live in a house/area introduced by a famous magazine or architect.
q) Areas that are being redeveloped by the government as "good places to live" are attractive.

Fig. 7. Bubble chart of behavioral biases scores.

4.1 % of respondents forming pairs with walkability, it is perceived that walkability may be somewhat compromised as long as transport accessibility is ensured.

3.4. Potential for residency promotion policies from a behavioral economics perspective

This section explores the potential of migration promotion measures based on various behavioral economics theories. Respondents' intentions were examined based on 17 questions related to five theories, including Sunk Costs. Fig. 7 presents a bubble chart illustrating the responses of participants to each item, ranging from "not at all" to "very much applicable."

Generally, the number of applicable responses was low. However, there was a tendency for a small number of items to be skewed toward both negative and positive opinions. Specifically, for question items a and b, the values for "somewhat applicable" and "not applicable" exceeded 100, while "not very much" was lower than these values. Items relatively biased toward the affirmative include the following: i) When we visit a city for the first time by train, if the station building and the square in front of the station are attractive, the whole city is considered a good area. On the contrary, a slight negative bias is observed in j) No matter how much we like the home/area, we feel differently if other people say it is not attractive; k) If our neighbors or people I know consider moving to a new place, we will want to move there; o) We want to live in a house/area recommended by a celebrity on TV, YouTube, etc., and p) We want to live in a house/area introduced by a famous magazine or architect.

As these psychological tendencies vary from person to person, cluster analysis was used to classify them into seven patterns. The characteristics of each cluster (CL) were then used to identify groups that could be more conducive to migration and the approaches that could have an impact on doing so (Fig. 8). These characteristics are presented below:

CL1. A strong status-quo thinker is easily influenced by the sunk-cost heuristic. The only possible approach is to adjust the impression of a station (heuristic).
CL2. Rational type with present bias, not influenced by Sunk Costs or heuristics. Less influenced by herding and bandwagons.
CL3. Similar to CL2, this type is less influenced by Sunk Costs and heuristics but, conversely, is influenced to a small extent by herding and obeying authority— a rational type with a relatively large number of approaches.
CL4. The stability-oriented type is not influenced by Sunk Costs but prioritizes heuristics, especially the familiar neighborhood and home in terms of a "familiar place rather than lifestyle." In addition, it has little influence after herding and is difficult to approach.
CL5. Influenced by heuristics but with lower Sunk Cost and current bias. The flexible-thinking type considers migration but prefers areas similar to their current residence.
CL6. Status quo types, such as CL1, are susceptible to Sunk Costs, present bias, and heuristics. However, owing to the influence of herding, more approaches can be considered than those in CL1.
CL7. The hyper-rational type can move if there is an excellent place to live while simultaneously choosing an area with fewer disadvantages in the future, even if it is somewhat challenging to live there. In return, there is less impact on Sunk Costs and damage.

Based on the above, CL3, CL2, CL7, CL5, CL6, CL1, and CL4 are the considerable CLs that could promote migration from the top to the bottom. Although some residents are more stability-oriented and

Sunk cost	a	Because we have paid our loans and rent, we should continue living in our current residence/area, even if we are dissatisfied.
	b	Because we have spent a lot of time and effort to get used to living here, we should continue to live in our current residence/area, even if we are dissatisfied.
	c	We should move if there is a better place to live, regardless of the time, effort, and money we have spent so far.
Present bias	d	If it were a city that would be very livable in a few years and a city that would be a little livable right now, we would live in the latter.
	e	If the city will be adamant about living in a few years and the city will be a little challenging to live in right now, we will live in the latter.
Heuristic	f	Even if there is a city that better suits our lifestyle, we will stay the same because we are used to living in the current area.
	g	If we were to move, we would prefer an area similar to our current area.
	h	We have had many good (bad) memories in my current area, and I will probably have many good (bad) events in my current area in the future.
	i	When we visit a city for the first time by train, if the station building and the square in front of the station are attractive, the whole city is a good area.
Bandwagon	j	No matter how much we like the home/area, we feel that way if other people say it is not attractive.
	k	If our neighbors or people I know consider moving to a new place, we will want to move there.
	l	When we see many new houses and buildings starting up, we imagine ourselves living there.
	m	When we read articles such as "The Best Places to Live," I feel that I would like to live in a town that ranks high on the list.
Herding	n	The house or area looks very nice when we see an eye-catching real estate advertisement.
	o	We want to live in a house/area recommended by a celebrity on TV, YouTube, etc.
Obedience to authority	p	We want to live in a house/area introduced by a famous magazine or architect.
	q	Areas that are being redeveloped by the government as "good places to live" are attractive.

Fig. 8. Box-plot chart of behavioral bias scores by clusters.

strongly desire to maintain the status quo, they may still consider migration to be accompanied by other psychological effects. While some rational CLs are more likely to stick to their idea of a suitable living environment, there is also a certain number that the bandwagon effect and other factors may influence.

3.5. Relationship between typologies of behavioral economics, respondent attributes, and loss aversion thinking

In the final analysis, this study explores which specific attributes may be suitable for promoting migration potential based on behavioral economics. To achieve this, the study examined age, household composition, income, and employment status, comparing them with the relevant tendencies of the identified behavioral economics CLs and respondents' willingness to continue living in their current residence. We

Table 4
Age characteristics of respondents likely to belong to each cluster.

	Young-aged	Middle-aged	Pre-retired	Early elderly	Elderly
CL1					
Measured value	4	13	16	31	22
Expected value	5.069	15.544	27.033	23.654	14.699
Significance of residue analysis			**		*
Determination of residue analysis			−		+
CL2					
Measured value	7	11	19	7	6
Expected value	2.947	9.037	15.717	13.752	8.546
Significance of residue analysis	*			*	
Determination of residue analysis	+			−	
CL3					
Measured value	9	26	56	36	17
Expected value	8.487	26.028	45.265	39.607	24.613
Significance of residue analysis			*		*
Determination of residue analysis			+		−
CL4					
Measured value	2	5	7	11	12
Expected value	2.181	6.688	11.631	10.177	6.324
Significance of residue analysis					*
Determination of residue analysis					+
CL5					
Measured value	6	23	42	30	17
Expected value	6.955	21.328	37.092	32.456	20.169
Significance of residue analysis					
Determination of residue analysis					
CL6					
Measured value	1	9	14	16	9
Expected value	2.888	8.857	15.403	13.477	8.375
Significance of residue analysis					
Determination of residue analysis					
CL7					
Measured value	1	5	6	9	4
Expected value	1.473	4.519	7.859	6.876	4.273
Significance of residue analysis					
Determination of residue analysis					

Significance of residure analysis.
Determination of residue analysis: + significantly more than expected, − significantly less than expected.
* $p < .05$.
** $p < .01$.

Table 5
Employment status characteristics of respondents likely to belong to each cluster.

	Formal employment	Informal employment	Other
CL1			
Measured value	28	6	53
Expected value	34.081	13.872	39.047
Significance of residue analysis		*	**
Determination of residue analysis		−	+
CL2			
Measured value	25	9	16
Expected value	19.587	7.972	22.441
Significance of residue analysis			
Determination of residue analysis			
CL3			
Measured value	52	28	63
Expected value	56.018	22.801	64.181
Significance of residue analysis			
Determination of residue analysis			
CL4			
Measured value	15	5	17
Expected value	14.494	5.9	16.606
Significance of residue analysis			
Determination of residue analysis			
CL5			
Measured value	56	19	43
Expected value	46.224	18.815	52.961
Significance of residue analysis	*		*
Determination of residue analysis	+		−
CL6			
Measured value	13	10	25
Expected value	18.803	7.654	21.543
Significance of residue analysis			
Determination of residue analysis			
CL7			
Measured value	10	4	11
Expected value	9.793	3.986	11.22
Significance of residue analysis			
Determination of residue analysis			

Significance of residure analysis.
Determination of residue analysis: + significantly more than expected, − significantly less than expected.
* $p < .05$.
** $p < .01$.

conducted the Pearson's chi-squared test and observed the relationship between two categorical data. Consequently, in the case of both "cluster and age" and "cluster and employment status," a *p*-value less than 0.05 was obtained, indicating that the null hypothesis has been declined. Thus, we analyzed the specific relationship between those two categories by the adjusted residue analysis.

Three items that violated Cochran's theorem were household composition, household income, and the intention to continue living in the same area/residence. Consequently, a Fisher's exact test was applied to these items to verify whether there were significant overall differences. Household composition and income did not exhibit significant differences ($p = .5252$ and $p = .1258$, respectively).

The overall difference in age was statistically significant, with a *p*-value of 0.02532, determined using the chi-square test. Table 4 summarizes the age differences obtained from the residue analysis. Significantly higher or lower than expected results are marked with * or **, respectively. Notably, CL1 had a higher representation among the elderly and a lower representation among the pre-retired group. Conversely, CL3 showed the opposite trend, with more respondents in

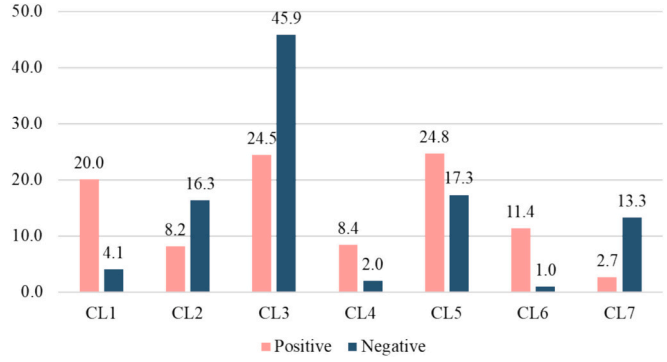


Fig. 9. Proportions of positive and negative responses by clusters (%).

the pre-retired group and fewer in the elderly group. CL2 was common among younger age groups and less common among the early elderly. CL4 was more common among older adults. For CL5 to CL7, there was no bias toward a particular generation, and the middle-aged group did not show values significantly above or below the expected value for any particular CL.

For employee status, the chi-square test results confirmed a statistically significant difference with a *p*-value of 0.03047. The results of the residue analysis are summarized in Table 5. Several trends emerged, confirming a tendency to be more or less than statistically expected compared to age. Specifically, in CL1, there was a trend toward more individuals in other employment categories and fewer in informal employment. In CL5, there was a tendency for formal employment to be higher than expected and, conversely, for other employment types to be lower than expected. No significant trends were observed for the other CLs.

Finally, we examined the differences in the intention to continue living in the area. Since error terms are not distributed as identically, independently, distributed with normal distribution, a Fisher's exact test was used, confirming a significant difference with a *p*-value of 0.0004998. However, because a Fisher's exact test is unsuitable for residue analysis, this study suppressed the proportion difference in each CL. Fig. 9 shows the response rate for each CL according to the intention to continue living in the residence. Those who responded positively tended to disperse across CL1, CL3, and CL5. In contrast, those with negative responses mainly belonged to CL3, followed by CL5, CL2, and CL7. The most significant difference between the positive and negative responses was the tendency for more positive responses to CL1 and more negative responses to CL7.

4. Discussion

This study aimed to employ a behavioral economics perspective to assess the potential for addressing migration in the Kyoto-Osaka-Kobe conurbation in Japan, focusing on areas expected to shrink to promote compactness. The results confirm a tendency toward loss aversion, but also reveal the applicability of factors such as residential environment items and Sunk Costs to CLs, with some observed dispersion. Additionally, respondents' attributes were found to differ depending on the CL, supporting the hypotheses of this study.

The initial assumption that approximately 80 % of respondents living on the periphery would prefer to continue living in their current location was generally validated. This trend suggests that Yamazaki et al.'s (2105) contention—that the number of people considering migration can increase by as much as 10 % when the convenience of their current place of residence declines significantly—can also occur in the fringe areas in the era of urban shrinkage. To promote voluntary migration, effective communication is necessary to clearly articulate the disadvantages of continuing to live in the periphery, provide incentives for moving, and address psychological aspects of the situation. In this context, a significant challenge lies in enhancing the understanding of the contents of the location normalization plan, especially clarifying the misconception that some people may have about falling within the area of residential attraction. This awareness should be highlighted when establishing residential attracting areas related to urban planning to promote a shift in residents' intentions. This indicates that the issue of recognition of residence attraction areas is a priority issue that needs to be resolved prior to the issues discussed in previous studies (e.g., Motomura et al., 2020; Takema & Sato, 2017) regarding the appropriateness of designated residence attraction areas and whether they can be induced based on their intrinsic environmental characteristics.

Loss aversion is evident across various aspects of the residential environment, except for items related to the community. This tendency is particularly pronounced for items related to convenience, safety, and comfort in daily life. While items related to hobbies and leisure activities also exhibit a tendency toward loss aversion, they are of lower priority, potentially influenced by the increased availability of online purchasing for hobby-related products. Accessibility to public transportation becomes crucial, allowing some flexibility even if stores are not located within walking distance. In terms of walkability, individuals may prioritize pedestrian spaces and road surface pavements over nature, such as street trees. Diminishing sensitivity is observed, indicating that individuals satisfied with their current living environment may still consider moving to a new area, even if it offers a slightly worse situation.

The Prospect Theory-based choice of residence proved to be a certain possibility, as did the migration process between countries and regions (Žičkutė & Kumpikaitė-Valiūnienė, 2015), as well as trends during periods of urban development and expansion (Yan et al., 2018). However, the tendency of individuals with a low evaluation of their current situation to be reluctant to move unless there is a possibility of significant improvement is a unique aspect of the shrinking situation. To promote future migration to a city, it is necessary to focus on making significant improvements to the residential environment within the residential attraction area, prioritizing comprehensive improvements over merely surpassing the current frontier area.

Regarding promoting migration using behavioral economics theory, each approach had varying degrees of success or failure, including considerations of Sunk Costs. This finding suggests that effective approaches should be implemented. While Sunk Costs and status-quo bias affect many people, others may be more receptive to approaches involving bandwagoning and herding. Based on these thinking characteristics, seven typologies were identified. This suggests that while there are individual differences in environmental conditions and other reasons for migration (Nishiyama et al., 2011), there are also individual differences in behavioral economic biases that can be affected. Among them, CLs unaffected by Sunk Costs, status-quo biases, heuristics, and rational types considering moving for an excellent living environment, were mainly young and pre-retired. Conversely, those who were pessimistic about continuing to live in their current location tended to fall into the relatively rational CL3, CL2, and CL7 categories.

However, irrational CLs influenced by Sunk Costs, heuristics, and status-quo bias were also identified, making it difficult to consider

alternative approaches. Elderly individuals were more likely to fall under L1 and CL4. There was also a significant trend among people with other employment types, possibly because of the inclusion of elderly retirees. Those with a positive intention to continue living in the area were more likely to belong to certain CLs. Promoting migration to the elderly appears challenging, and it seems more reasonable to focus on approaching the younger generation and those approaching retirement. Furthermore, individuals in the most neutral CL5 were likely to be in formal employment. While they may desire flexibility in choosing a better place of residence, they may need assistance because of their relationship with the workplace, a factor that could not be addressed in this study.

In light of these discussions, we would need to include a behavioral economics perspective in our migration promotion policies. Specifically, the incentives for encouraging people to move to residence attraction areas need to be set based on the psychology of Sunk Costs, rather than on gains and losses based solely on the current situation. This is especially necessary when encouraging the elderly population that has been settled for a long time to move to the area. In addition, as Gim, (2023) suggests, the younger generation is more likely to value urban convenience and is better suited to encouraging mobility. Also, according to Aoki (2023c), pre-retirees should be approached in order to achieve compactness in a short period of time. In contrast, the results of this study suggest that these younger and pre-retired people are psychologically more willing to migrate. While there have been scattered approaches to the younger generation by attracting workplaces to the center of the city, no approaches have been proposed for the pre-retirement population (Aoki, 2023c), and this is a perspective that may be necessary for the next migration promotion measures.

The results based on behavioral economics biases other than Sunk Cost and Prospect Theory also revealed findings that contribute to more rapid intensification. Particularly, improving the city's image by improving the area in front of the station and communicating this information to the public through media and government channels is essential. In this sense, the recent redevelopment of station fronts, establishment of urban functional guidance zones around major public transportation stations, and concept of concentrating destinations for lifestyle activities other than workplaces in station spheres (Aoki, 2023a) are considered to have a particular impact. However, land and financial resources are limited, necessitating a prioritization of the development of a living environment based on loss aversion.

5. Conclusion

This study analyzed the possibility of adapting behavioral economics theories to address peripheral resident movements to ensure the compactness of cities. As discussed, Prospect Theory can be adapted to residential environments, and other perspectives offer alternative opportunities to promote migration. These findings contribute to the creation of a compact conurbation, fostering spontaneous and satisfactory migration, and introducing behavioral economics to the study of migrating peripheral residents for the first time. Thus, our research contributes to the discourse on shrinking cities and the promotion of compact urban areas. While more region-specific advanced analyses may be warranted, our research suggests the potential for conducting a global survey on the psychological obstacles to migration.

However, this study has some limitations. First, it focused on a specific conurbation with a declining population. In addition, because the main objective was to contribute to city downsizing, it was necessary to thoroughly investigate the intentions of residents living in central urban areas or station squares. Furthermore, although we were able to clarify the possibility of incorporating a behavioral economics perspective, a concrete understanding is still needed, such as determining which media should be used to disseminate information or what constitutes a good station area.

Moreover, in this paper, we have yet to be able to determine which behavioral economics biases are most important to respondents. Therefore, further analysis is needed to normalize and weight the bias categories in the same way so that each bias has the same minimum and maximum scores. In addition, the limitations of the survey instrument limit the analysis to categorical data. In order to examine the combination of attributes of people whose residential behavior is more likely to be influenced by behavioral economics theory, interval scale data must be obtained for respondent attributes as well and the possibility of performing multiple regression analysis must be considered.

Because the geodetic survey method uses questionnaire distribution, this survey may be susceptible to response formation effects and may have some difficulty invalidating. These points should continue to be examined through the improvement of the survey instrument or the establishment of a different social experiment method in conjunction with the establishment of a quantitative survey method as described above.

The following perspectives are needed for further research development based on the above limitations. To develop more accurate migration promotion policies incorporating behavioral economics perspectives, more surveys and comparisons are needed in smaller conurbations and those still in the developmental stage of growth. In addition, it is essential to compare and verify whether the results obtained in this study are unique to residents living on the periphery, after organizing the intentions of people living in different areas. Finally, as this survey was mainly a questionnaire survey, it is necessary to conduct interviews with each category of respondents, including those considering migration, those not considering migration, and those who have moved to the city, to gain a perspective for considering more specific approaches.

Founding

This research was supported by a grant from the Dai-ichi Life Foundation for "Incentive Research on the field of City & Life 2022".

CRediT authorship contribution statement

Takashi AOKI: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of interests

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Takashi AOKI reports financial support was provided by Dai-ichi Life Fundation.

Data availability

Data will be made available on request.

Acknowledgment

We would like to thank Editage (www.editage.com) for the English language editing. This research was funded by the Dai-ichi Life Foundation Research Grant Program.

Appendix A. The Questionnaire Survey used in this Study-1.

Q) Can you tell us about your attributes?

Age: ☐Young-aged (20-34 years old), ☐Middle-aged (35-49 years old), ☐Pre-retired (50-64 years old), ☐Early elderly (65-74 years old), ☐Elderly (over 75 years old),

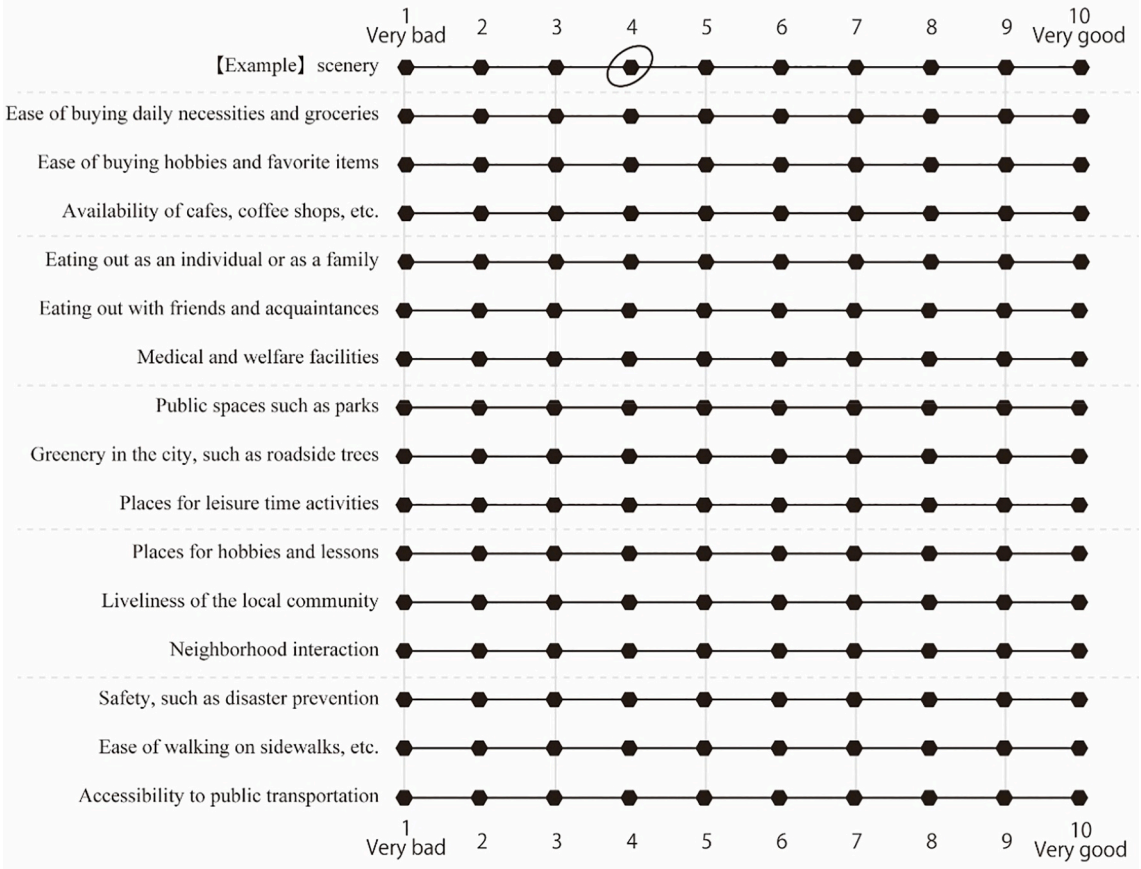
Household composition: ☐Single, ☐Couple, ☐Nuclear family, ☐Other,

Annual household income: ☐under 4 million yen, ☐4 to 6 million yen, ☐6 to 8 million yen, ☐8 to 10 million yen, ☐more than 10-million-yen

Employment status: ☐Formal employment, ☐Informal employment, ☐Other.

Q) Looking back at your current neighborhood, what do you think of the following items?

Please rate how many points you would rate them, with 1 being "very bad" and 10 being "very good" .



Appendix B. The Questionnaire Survey used in this Study-2.

Q) Suppose that the environment of your neighborhood will change in the future due to moving or redevelopment. In that case, the environment in the new area could be better or worse than it is now. If there is a 50% risk that each of the following items will be "a little worse than where you live now," while there is a half chance that the same item will be "how much better than where you live now" in the other half of the cases, would you decide to live in that area?

	About the same	A little better	Fairly better	Much better	Very much better
【Example】 scenery		○			
Ease of buying daily necessities and groceries					
Ease of buying hobbies and favorite items					
Availability of cafes, coffee shops, etc.					
Eating out as an individual or as a family					
Eating out with friends and acquaintances					
Medical and welfare facilities					
Public spaces such as parks					
Greenery in the city, such as roadside trees					
Places for leisure time activities					
Places for hobbies and lessons					
Liveliness of the local community					
Neighborhood interaction					
Safety, such as disaster prevention					
Ease of walking on sidewalks, etc.					
Accessibility to public transportation					

Q) Suppose that when the environment in which you live changes, in order to make some items better, you have to accept that another item will be worse. At this time, which item would you give up in place of which item?

【Pair 1】 Chose [ ], instead [ ]

【Pair 2】 Chose [ ], instead [ ]

【Pair 3】 Chose [ ], instead [ ]

a) Ease of buying daily necessities and groceries
b) Ease of buying hobbies and favorite items
c) Availability of cafes, coffee shops, etc.
d) Eating out as an individual or as a family
e) Eating out with friends and acquaintances
f) Medical and welfare facilities
g) Public spaces such as parks
h) Greenery in the city, such as roadside trees
i) Places for leisure time activities
j) Places for hobbies and lessons
k) Liveliness of the local community
l) Neighborhood interaction
m) Safety, such as disaster prevention
n) Ease of walking on sidewalks, etc.
o) Accessibility to public transportation

Appendix C. The Questionnaire Survey used in this Study-3.

Q) When you think about "living in," do the following ideas apply to your thoughts?

	Not at all	Not applicable	Not very much	Somewhat applicable	Applicable	Very much applicable
Because we have paid loans and rent, we should continue to live in our current residence/area even if we are dissatisfied.						
Because we have spent a lot of time and effort getting used to living here, we should continue to live in our current residence/area, even if we are dissatisfied.						
We should move if there is a better place to live, regardless of the time, effort, or money spent.						
I would choose to live in a city that would be a little livable right now, compared to a city that would be very livable after a few years.						
I would choose to live in a city that would be a little challenging to live in right now, compared to a city that would be very challenging to live in after a few years.						
Even if there is a city that better suits our lifestyle, we will stay the same because we are accustomed to living in our current area.						
If we were to move, we would prefer an area similar to our current area.						
I have had many good (bad) memories of my current area and I will probably have many good (bad) events in my current area in the future.						
When we visit a city for the first time by train, if the station building and the square in front of the station are attractive, the entire city is considered a good area						
No matter how much we like the home/area, we feel differently if other people say it is not attractive.						
If our neighbors or people I know consider moving to a new place, we will want to move there.						
When we see many new houses and buildings, we imagine ourselves living in them.						
When we read articles such as "The Best Places to Live," I felt that I would like to live in a town that ranks highly on the list.						
The house or area looks nice when we see an eye-catching real estate advertisement.						
We want to live in a house/area recommended by a celebrity on TV, YouTube, etc.						
We want to live in a house or area introduced by a famous magazine or architect.						
Areas being redeveloped by the government as "good places to live" are attractive.						

References

Agency, N. T. A. (2022). *Survey of private sector salaries as of 2022*. Tokyo: National Tax Administration Agency. https://www.nta.go.jp/publication/statistics/kokuzeicho/minkan/gaiyou/2022.htm (in Japanese).

Aoki, T. (2022a). The possibility of reorganising transit-oriented development. *International Review for Spatial Planning and Sustainable Development, 10*(4), 55–78. https://doi.org/10.14246/irspsd.10.4_55

Aoki, T. (2022b). Confronting future urban perforation: Spatial analysis of districts in Japan with potential for being sparsely inhabited. *Cities, 122*, Article 103515. https://doi.org/10.1016/j.cities.2021.103515

Aoki, T. (2023a). Activity space compactness index from the viewpoint of trip arrival point by lifestyle activity purpose in a mature conurbation. *Sustainable Cities and Society, 88*, Article 104302. https://doi.org/10.1016/j.scs.2022.104302

Aoki, T. (2023b). Possibility of re-organizing the compact urban structure in the Japanese conurbation from the trip destination prospect. *Urban and Regional Planning Review, 10*, 136–157. https://doi.org/10.14398/urpr.10.136 (in Japanese)

Aoki, T. (2023c). Which generation should migration promotion measures target to shortly achieve a compact structure for shrinking cities? *Cities, 150*, Article 105020. https://doi.org/10.1016/j.cities.2024.105020

Arkes, H. R., & Ayton, P. (1999). The sunk cost and Concorde effects: Are humans less rational than lower animals? *Psychological Bulletin, 125*(5), 591–600. https://doi.org/10.1037/0033-2909.125.5.591

Bernt, M. (2007). Six years of Stadtumbau Ost (urban restructuring east) programme: Difficulties of dealing with shrinking cities. In M. Langner, & W. Endlicher (Eds.), *Shrinking cities: Effects on urban ecology and challenges for urban development.* Frankfurt am Main: Peter Lang Verlagsgruppe.

Bernt, M. (2019). The emergence of "Stadtumbau Ost". *Urban Geography, 40*(2), 174–191. https://doi.org/10.1080/02723638.2017.1332926

Chhetri, P., Han, J. H., Chandra, S., & Corcoran, J. (2013). Mapping urban residential density patterns: Compact city model in Melbourne, Australia. *City, Culture and Society, 4*(2), 77–85. https://doi.org/10.1016/j.ccs.2013.03.001

City Planning Division, M. L. I. T. (2018). *Toshi no Suponge-Ka Taisaku, Katsuyo study Syu [urban perforation control, collection of application studies].* MLIT. (in Japanese).

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.

Czaika, M. (2015). Migration and economic prospects. *Journal of Ethnic and Migration Studies, 41*(1), 58–82. https://doi.org/10.1080/1369183X.2014.924848

De Roo, G. (1998). Environmental planning and the compact city a Dutch perspective. *Studies in Environmental Science, 72*, 1027–1042. https://doi.org/10.1016/S0166-1116(98)80061-7

Denis, M., Cysek-Pawlak, M. M., Krzystofik, S., & Majewska, A. (2021). Sustainable and vibrant cities. Opportunities and threats to the development of polish cities. *Cities, 109*, Article 103014. https://doi.org/10.1016/j.cities.2020.103014

Gim, T. H. T. (2023). Residential self-selection or socio-ecological interaction? The effects of sociodemographic and attitudinal characteristics on the built environment–travel behavior relationship. *Transportation, 50*, 1347–1398. https://doi.org/10.1007/s11116-022-10280-1

Haase, D., Haase, A., & Rink, D. (2014). Conceptualizing the nexus between urban shrinkage and ecosystem services. *Landscape and Urban Planning, 132*, 159–169. https://doi.org/10.1016/j.landurbplan.2014.09.003

Hartt, M. (2021). *Quietly shrinking cities: Canadian urban population loss in an age of growth.* Vancouver: University of British Columbia Press.

Hashimoto, K., Musha, T., Kikuchi, Y., Kukimoto, M., Komaki, N., & Sato, M. (2021). Local government evaluation and recognition of the location normalization plan: Questionnaire survey results from 332 municipalities. *E-journal GEO, 16*(1), 33–47. https://doi.org/10.4157/ejgeo.16.33 (in Japanese)

Hattori, K. (2016). *Doitsu Shukushotoshi-jidai no Toshi-Design [urban design under shrinkage in Germany].* Gakugei Publishing (in Japanese).

Hattori, K., Kaido, K., & Matsuyuki, M. (2017). The development of urban shrinkage discourse and policy response in Japan. *Cities, 69*, 124–132. https://doi.org/10.1016/j.cities.2017.02.011

Hollander, J. B., Pallagst, K., Schwarz, T., & Popper, F. (2009). Planning shrinking cities. *Progress in Planning, 72*(4), 223–232.

Hong, Z., Su, Y., & Chang, H. (2023). Analyzing the relationship between income and life satisfaction of Forest farm households - a behavioral economics approach. *Forest Policy and Economics, 148*, Article 102916. https://doi.org/10.1016/j.forpol.2023.102916

Housing Bureau, M. L. I. T. (2022). *Aki-ya Seisaku no Genjo to Kadai oyobi Kento no Hokosei [current status and issues of vacant house policy and direction of study].* MLIT. (in Japanese).

Hwang, S., & Salmon, M. (2004). Market stress and herding. *Journal of Empirical Finance, 11*(4), 585–616. https://doi.org/10.1016/j.jempfin.2004.04.003

Inagaki, M. (2001). The compact city policy in the Netherlands. *The Japanese Journal of Real Estate Sciences, 15*(3), 49–55. https://doi.org/10.5736/jares1985.15.3_49 (in Japanese)

Institute of Populations and Social Security (IPSS). (2016). *Demographic datasets as of 2016*. Demographic Data Collection, Tokyo: IPSS. http://www.ipss.go.jp/syoushika/tohkei/Popular/Popular2016.asp?chap=4&title1=%87W%81D%8Fo%90%B6%81E%89%C6%91%B0%8Cv%89%E6 (in Japanese).

Jarzebski, M. P., Elmqvist, T., Gasparatos, A., Fukushi, K., Eckersten, S., Haase, D., … Pu, J. (2021). Ageing and population shrinking: Implications for sustainability in the urban century. *Npj Urban Sustainability, 1*, 17. https://doi.org/10.1038/s42949-021-00023-z

Just, D. R. (2013). *Introduction to behavioral economics: Noneconomic factors that shape economic decisions*. New York: John Wiley & Sons, Inc.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 46*, 171–185.

Kötter, T. (2019). Urban development. In L. Kühnhardt & T. Mayer (Eds.), The Bonn handbook of Globality*: Volume 1*. Springer Verlag. pp. 701–712. DOI:https://doi.org/10.1007/978-3-319-90377-4_61.

Mallach, A. (2023). *Smaller cities in a shrinking world: Learning to thrive without growth.* Washington: Island press.

Mallach, A., Haase, A., & Hattori, K. (2017). The shrinking city in comparative perspective: Contrasting dynamics and responses to urban shrinkage. *Cities, 69*, 102–108. https://doi.org/10.1016/j.cities.2016.09.008

Marsh, C. (1985). Back on the bandwagon: The effect of opinion polls on public opinion. *British Journal of Political Science, 15*(1), 51–74. https://doi.org/10.1017/S0007123400004063

Milgram, S. (1965). Some conditions of obedience and disobedience to authority. *Human Relations, 18*(1), 57–76. https://doi.org/10.1177/001872676501800105

Ministry of Land, Infrastructure, Transport and Tourism (MLIT). (2015). *Kaisei Toshi-Tokubetsu Sochi-ho Tou Ni Tsuite [revised urban special measures law, among others].* MLIT. (in Japanese).

Motomura, K., Maruoka, A., Matsukawa, T., & Nakade, B. (2020). Study on the ideal way of the designation of residential promotion area. *Journal of the City Planning Institute of Japan, 55*(3), 521–528. https://doi.org/10.11361/journalcpij.55.521 (in Japanese)

Nadeem, M., Aziz, A., Ahmad, M., Tesoriere, G., Asim, M., & Campisi, T. (2021). Scaling the potential of compact city development: The case of Lahore. *Pakistan. Sustainability, 13*(9), 5257. https://doi.org/10.3390/su13095257

Nakatani, T., Higuchi, S., Nakade, B., & Matsukawa, T. (2019). Issues towards promoting residence in downtown areas from the perspective of residential selection intentions of households living in newly built detached houses in local cities. *Journal of the City Planning Institute of Japan, 54*(3), 1222–1228. https://doi.org/10.11361/journalcpij.54.1222 (in Japanese)

Nelle, A., Großmann, K., Haase, D., Kabisch, S., Rink, D., & Wolff, M. (2017). Urban shrinkage in Germany: An entangled web of conditions, debates and policies. *Cities, 69*, 116–123. https://doi.org/10.1016/j.cities.2017.02.006

Nishii, S., Manabe, R., & Murayama, A. (2019). Policies and backgrounds for setting residential promotion areas in location normalization plans. *Journal of the City Planning Institute of Japan, 54*(3), 532–538. https://doi.org/10.11361/journalcpij.54.532 (in Japanese)

Nishiyama, Y., Nakatani, J., Kurisu, K., Aramaki, T., & Hanaki, K. (2011). Analysis of residential choice behavior based on classification of residential preferences. *Journal of Japan Society of Civil Engineers, Ser. G (environmental research), 67*(6). https://doi.org/10.2208/jscejer.67.II_1. II_1-II_10. (in Japanese).

Oswalt, P., & Rieniets, T. (2006). *Atlas of shrinking cities*. Ostfildern-Ruit: Hatje Cantz Publishers.

Reis, J. P., Silva, E. A., & Pinho, P. (2016). Spatial metrics to study urban patterns in growing and shrinking cities. *Urban Geography, 37*(2), 246–271. https://doi.org/10.1080/02723638.2015.1096118

Rink, D., & Siemund, S. (2016). Perforation as a Planning model for shrinking cities? Experiences from the City of Leipzig. *disP - the. Planning Review, 52*(3), 50–60. https://doi.org/10.1080/02513625.2016.1235879 (in German).

Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty, 1*, 7–59. https://doi.org/10.1007/BF00055564

Shah, A. K., & Oppenheimer, D. M. (2008). Heuristics made easy: An effort-reduction framework. *Psychological Bulletin, 134*(2), 207–222. https://doi.org/10.1037/0033-2909.134.2.207

Shen, L., Jorge Ochoa, J., Shah, M. N., & Zhang, X. (2011). The application of urban sustainability indicators – A comparison between various practices. *Habitat International, 35*(1), 17–29. https://doi.org/10.1016/j.habitatint.2010.03.006

Takema, M., & Sato, T. (2017). Development of the population distribution estimation method in a city to examine the measures to attract residence based on the location optimization plan and a case study for Toyohashi City, Japan. *Journal of the City Planning Institute of Japan, 52*(3), 1124–1129. https://doi.org/10.11361/journalcpij.52.1124 (in Japanese)

Takemoto, T., Akai, N., & Kutsuzawa, R. (2019). Influence of making cities less compact due to declining population on municipal finances: Simulation analysis using "normalized standard distance." Public Finance Studies, 15, 163–180. doi:10.50898/pfsjipf.15.0_163(in Japanese).

Wang, M., Bao, X. H., & H., & Lin, P-t.. (2015). Behavioral insights into housing relocation decisions: The effects of Beijing Olympics. *Habitat International, 47*, 20–28. https://doi.org/10.1016/j.habitatint.2015.01.001

Weaver, R., Bagchi-Sen, S., Knight, J., Frazier, A., & E.. (2016). *Shrinking cities: Understanding urban decline in the United States*. London: Routledge.

Yamazaki, A., Takashi, K., Chikaraishi, M., Ohmori, N., & Harata, N. (2015). Fundamental study on measures to promote compact relocation focused on showing merits and demerits of residence. *Journal of the City Planning Institute of Japan, 50*(1), 20–27. https://doi.org/10.11361/journalcpij.50.20 (in Japanese)

Yan, J., Bao, X. H., & H.. (2018). A Prospect theory-based analysis of housing satisfaction with relocations: Field evidence from China. *Cities, 83*, 193–202. https://doi.org/10.1016/j.cities.2018.06.022

Žičkutė, I., & Kumpikaitė-Valiūnienė, V. (2015). Theoretical insights on the migration process from economic Behaviour's perspective. *Procedia-Social and Behavioral Sciences, 213*, 873–878. https://doi.org/10.1016/j.sbspro.2015.11.498